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STICK REMOVERS VERSUS CYLINDER CLEANERS IN COTTON GINS

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STICK REMOVERS VERSUS CYLINDER CLEANERS IN COTTON GINS

By Charles S. Shaw¹

ABSTRACT

Experiments were performed to determine the effects of a commercial-type stick remover on seed-cotton-cleaning and spinning performance. Resulting data indicated that this type of machine facilitates seed-cotton cleaning and contributes towards improved grades without having adverse effects on the fiber and spinning quality of cotton. A 3-year followup investigation was conducted to evaluate the USDA-developed stick remover versus cylinder cleaners in combination with two stages of saw-cylinder lint cleaning. The results showed that there were no significant differences in any of the measured lint or yarn quality factors attributable to seed-cotton-cleaning treatments. These data also indicated that none of the seed-cotton-cleaning arrangements in combination with two stages of saw-cylinder lint cleaning was superior to the conventional seed-cotton-processing sequence of drier, cylinder cleaner, stick and leaf machine, drier, and cylinder cleaner when used with two stages of lint cleaning.

INTRODUCTION

For many years the Agricultural Research Service's U.S. Cotton Ginning Research Laboratory at Stoneville, Miss., has been successful in the research and development of seed-cotton-cleaning machinery for the removal of sticks, stems, and green-leaf material. Franks and Shaw, in a rather comprehensive USDA publication, described the USDA-developed, unit-type stick remover.² Gin machinery manufacturing companies were quick to recognize the effectiveness of the machine and have engaged in the manufacture of various adaptations of its stick-removing principle of cleaning. These machines are available to the cotton-ginning industry and are widely used.

A study was conducted in 1967 to determine the effects of a commercial-type stick remover on cleaning and spinning performance. These experiments were in response to complaints from some mills that the commercial-type stick remover has had an adverse effect on spinning performance and, therefore, should be bypassed in custom ginning. A 3-year followup investigation (1968-70) was designed to evaluate using the USDA-developed stick remover in lieu of cylinder cleaners in order to consider recommendations to industry for more effective seed-cotton cleaning. This report presents the equipment and procedures used in, and the results of, these experiments.

1967 STUDY

Equipment and Procedures

Three series of experiments were performed in the full-size laboratory gin at Stoneville, using early-, middle-, and late-season machine-picked cotton.

The following machinery arrangements were

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² Franks, G. N., and Shaw, C. S. 1959. Stick remover for cotton gins. U.S. Dep. Agric. Prod. Res. Rep. No. 22, 39 pp.

used in three replications for each of three stages of harvesting: (1) Drier, 6-cylinder cleaner, commercial-type stick and leaf machine, 6-cylinder cleaner, feeder cleaner, and two lint cleaners and (2) same arrangement with the stick and leaf machine bypassed. All the cotton was ginned in a 16-inch, 79-saw gin stand.

Results

Data for foreign-matter content of the seed cotton are given in table 1. These data show an increase in foreign-matter removal with the use of the stick and green-leaf machine.

Data on grade classification, lint-foreign-matter content, and moisture content are presented in table 2. Use of the stick and green-leaf machine provided a grade index of 96.5, as compared to 95.0 without the machine, but staple length was not affected.

Spinning and fiber data are presented in table 3. Data for the late-season cotton are shown separately because this cotton had an unusually heavy mote and immature, fine-fiber content.

The fiber for the late-season cotton was below scale on the micronaire and had unusually high nep counts, while the micronaire readings for the early- and middle-season cottons averaged 4.8. Data for the early- and middle-season cottons show essentially the same spinning results, with or without use of the stick and green-leaf machine. Nep count was 14, picker and card waste was 6.3 percent, and uniformity was 46 percent. There was no significant difference in fiber length, carded yarn strength, or average yarn appearance.

Seed-cotton cleaning with the commercial-type stick and green-leaf machine provided slightly lower picker and card waste without having any adverse effects on fiber and spinning quality.

1968 STUDY

Equipment and Procedures

Past studies have shown that the USDA stick remover with restraining grid rods, which

TABLE 1.—*Percentage of foreign matter in seed cotton on wagon and after cleaning with and without a commercial-type stick and leaf machine, 1967¹*

Ginning treatment	Hulls	Small sticks and stems	Grass	Leaves	Pin trash	Motes	Total
Wagon	1.7	0.6	0.1	2.9	0.2	1.6	7.1
Feeder:							
With stick machine .....	.2	.4	0.0	.9	.1	1.0	2.6
Without stick machine .....	.3	.4	.03	1.1	.1	1.0	2.9

¹ Figures are averages of 27 samples, or 9 for each of 3 replications. Early-, middle-, and late-season cottons were combined.

TABLE 2.—*Average grade classification, lint-foreign-matter content, and moisture content of seed cotton cleaned with and without a commercial-type stick and leaf machine, 1967¹*

Ginning treatment	Grade index ²	Staple length (32d in)	Lint foreign matter (pct)	Moisture (pct)	
				Wagon sample	Lint sample
With stick machine	96.5	34.6	2.2	10.4	4.9
Without stick machine	95.0	34.6	2.3	11.2	5.1

¹ Early-, middle-, and late-season cottons were combined.

² 100 = Middling.

TABLE 3.—*Spinning and fiber properties of seed cotton cleaned with and without a commercial-type stick and leaf machine, 1967¹*

Measurement	Seed cotton					
	Early- and middle-season		Late-season		Early-, middle-, and late-season	
	With stick machine	Without stick machine	With stick machine	Without stick machine	With stick machine	Without stick machine
2.5-pet span length inch . . .	1.09	1.10	1.08	1.09	1.09	1.09
Uniformity pct	46	46	40	40	44	44
Neps 100 in ² of						
card web	14	14	62	92	30	40
Picker and card waste pct . . .	6.3	6.3	6.3	6.9	6.3	6.5
Carded yarn strength:						
22s yarn lb	101	102	110	113	104	106
50s yarn lb	33	34	38	39	35	36
Yarn appearance index	99	98	60	60	86	86
Yarn break factor	1,936	1,969	2,160	2,226	2,010	2,054

¹ Figures represent 3 spinning tests for each stage of harvesting, e.g., the early, middle, and late combined data are averages of 9 spinning test lots with the stick and leaf machine and 9 without the machine.

employs the principle of centrifugal force, does a better job of all-round foreign-matter removal than cylinder cleaners (fig. 1). The study in 1968 was made in the microgin at Stoneville to further evaluate and confirm use of the USDA stick remover.

Four series of experiments, using machine-picked seed cotton, were conducted to make this evaluation.

The following five overhead gin machinery arrangements or setups were used in addition to driers, feeder, and two lint cleaners:

1. 6-cylinder cleaner, stick remover, 6-cylinder cleaner.
2. 6-cylinder cleaner, 6-cylinder cleaner.
3. 6-cylinder cleaner, stick remover.
4. 6-cylinder cleaner, stick remover, stick remover.
5. Stick remover, stick remover.

Results

Average foreign-matter content of the seed cotton for the experiments is given in table 4. The total foreign-matter content of the wagon samples was 6.1 percent, and this was reduced to a low of 1.1 percent at the feeder apron with the No. 4 setup, where single 6-cylinder and double-stick-remover cleaning was used (fig. 2).

Essentially the same degree of cleaning was accomplished with the No. 4 and No. 5 setups,

in which double-stick-remover cleaning was used, but the 6-cylinder cleaner used in the No. 4 setup did provide somewhat slightly better final leaf removal.

Data on grade classification, moisture content, lint-foreign-matter content, fiber and miniature spinning properties, and nep count are presented in table 5. These data show slightly higher grade-index values and significantly lower lint foreign

TABLE 4.—*Percentage of foreign matter in seed cotton for USDA stick-remover study, 1968¹*

Measurement component	Wagon sample	Feeder samples from gin-machinery arrangement No. —				
		1	2	3	4	5
Hulls	1.9	0.2	0.4	0.4	0.2	0.2
Sticks and stems . . . . .	.4	.2	.3	.2	.2	.2
Large-leaf	1.1	.2	.2	.2	.1	.2
Small-leaf	1.7	.2	.3	.3	.2	.2
Total leaf	2.8	.4	.5	.5	.3	.4
Pin trash . . . . .	.2	0.0	0.0	.1	0.0	0.0
Motes . . . . .	.5	.4	.4	.3	.4	.4
Twists . . . . .	.3	.1	.1	.1	0.0	0.0
Total all foreign matter	6.1	1.3	1.7	1.6	1.1	1.2

¹ Wagon sample figures are averages of 180 samples, or 45 from each of 4 replications. Feeder sample figures are averages of 36 samples, or 9 from each of 4 replications.

matter for Nos. 4 and 5, setups, and there were no adverse effects on fiber-array lengths or spinning-test values.

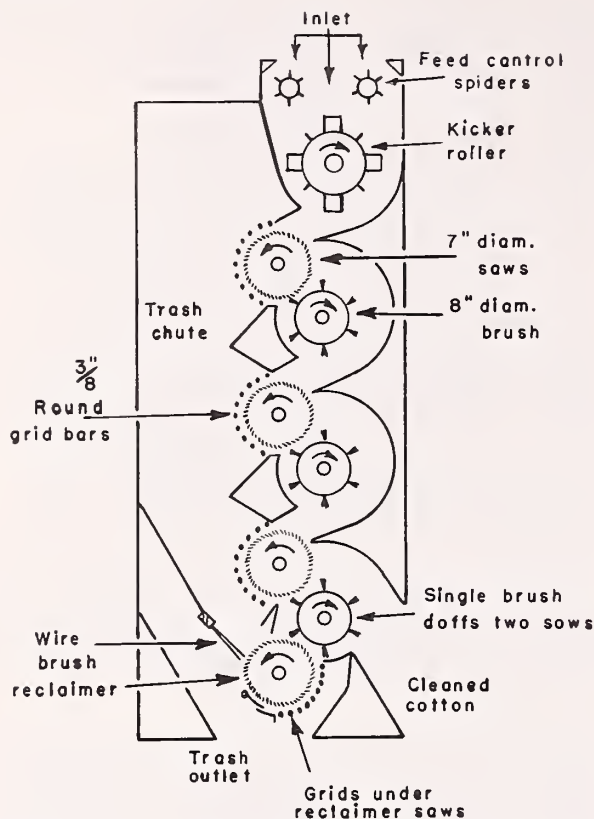


FIGURE 1.—Cross-sectional view of USDA-developed stick remover.

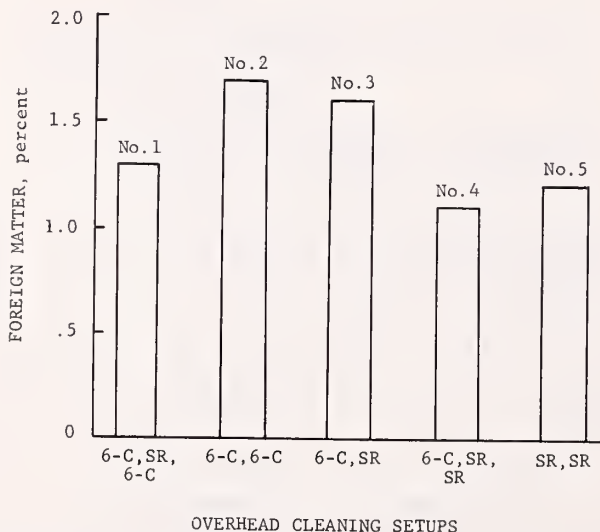


FIGURE 2.—Foreign-matter content of feeder samples for USDA stick-remover study, 1968. (6-C, 6-cylinder cleaner; SR, USDA stick remover.)

The nep count of 33 for the No. 5 setup was the same as for the No. 1 control or normal setup consisting of 6-cylinder cleaner, stick remover, and 6-cylinder cleaner. The highest average nep count of 36 was with the No. 4 setup. The double-stick-remover setup without cylinder cleaning (No. 5) gave lint-foreign-matter results equal to or better than the other four cleaning setups (fig. 3).

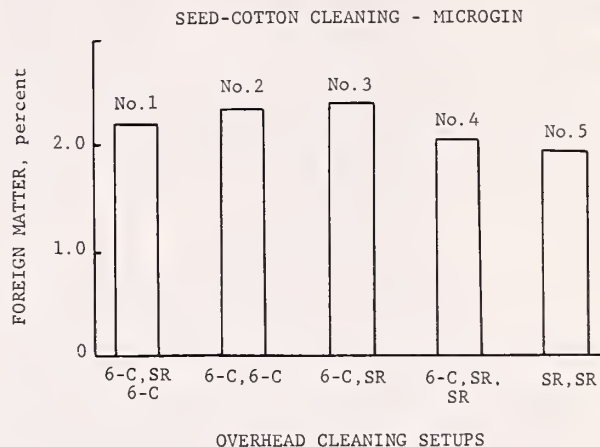


FIGURE 3.—Lint-foreign-matter content of seed cotton for USDA stick-remover study, 1968. (6-C, 6-cylinder cleaner; SR, USDA stick remover.)

1969 STUDY

Equipment and Procedures

In 1969, three series of experiments, using machine-picked seed cotton, were conducted in the microgin to further evaluate use of the USDA stick remover in lieu of a second 6-cylinder cleaner.

The following five overhead-gin-machinery arrangements or setups were used in addition to driers and feeder, with none and two lint cleaners:

1. 6-cylinder cleaner, stick remover, 6-cylinder cleaner.
2. 6-cylinder cleaner, 6-cylinder cleaner.
3. 6-cylinder cleaner, stick remover.
4. 6-cylinder cleaner, stick remover, stick remover.
5. Stick remover, stick remover.

Results

A summary of the seed-cotton-cleaning results for the experiments is given in table 6. The total

TABLE 5.—*Grade classification, moisture content, lint-foreign-matter content, and fiber and spinning properties of seed cotton for USDA stick-remover study, 1968¹*

Measurement	Seed-cotton samples from gin-machinery arrangement No.—				
	1	2	3	4	5
Grade characteristic:					
Grade index	95.5	95.5	95.3	95.8	95.7
Staple length 32d inch	34.8	34.8	34.9	34.8	34.7
Moisture content:					
Wagon pct	12.7	12.0	11.6	12.7	12.6
Feeder pct	10.6	10.2	10.5	9.4	10.3
Lint pct	6.4	5.8	6.0	5.8	5.7
Lint-foreign-matter					
content pct	2.21	2.34	2.40	2.06	1.95
Fiber or miniature spinning					
property:					
50-pct span length inch	0.49	0.48	0.47	0.48	0.48
2.5-pct span length inch	1.16	1.16	1.14	1.15	1.15
Uniformity pct	42	41	41	41	41
Yarn skein strength lb	115	115	113	114	115
Coefficient of variation pct	4.2	4.3	4.7	4.4	4.6
Micronaire reading	4.1	4.1	4.1	4.2	4.1
Neps/100 in ² of web	33	29	31	36	33
Upper quartile length inch	1.27	1.27	1.27	1.27	1.27
Fibers shorter than ½ inch ... pct	11.5	11.8	11.8	11.5	11.8

¹ Grade, moisture, and lint-foreign-matter data are averages of 36 samples, or 9 from each of 4 replications. Miniature spin-test data and nep data are averages of 12 samples, or 3 from each of 4 replications. Fiber-array data are averages of 4 samples composed of 1 composite sample from each of 4 replications. All setups included drying, feeder, and double lint cleaning.

foreign-matter content of the wagon samples was 4.4 percent, and this value was reduced to a low of 0.8 percent at the feeder apron with the No. 4 setup, where one 6-cylinder and double-stick-remover cleaning was used (fig. 4).

Essentially the same degree of seed-cotton cleaning was accomplished with both the No. 4 and No. 5 setups, in which double-stick-remover cleaning was used, but the 6-cylinder cleaner used in the No. 4 setup did provide somewhat slightly better final mote removal.

Data on grade classification, moisture content, lint-foreign-matter content, and nep count are presented in table 7. The best all-round results, from a grade and cleaning standpoint, were obtained with the No. 4 setup, which had no adverse effects on nep count or on fiber and spinning test values (table 8). In all cases more than one-half of a grade of cleaning was added by using the two lint cleaners (table 7).

The nep count of 14 for the double-stick-remover setup (No. 5) without lint cleaning was the same as for the No. 1 control or normal setup,

consisting of 6-cylinder cleaner, stick remover, and 6-cylinder cleaner. The highest average nep count of 25 was with the No. 4 setup and two lint cleaners. Once again nep counts increased with lint cleaning. The double-stick-remover setup (No. 5), which had no cylinder cleaning, gave

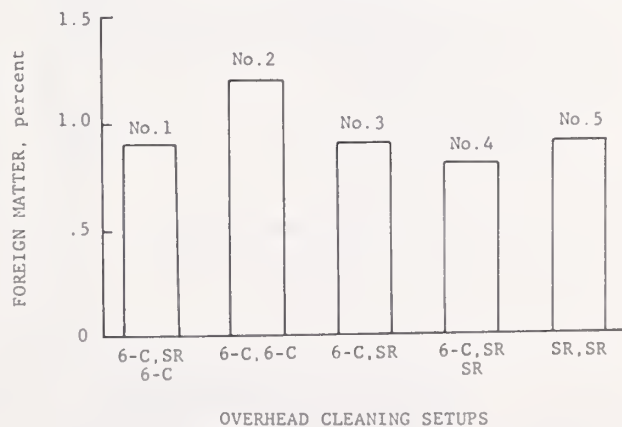


FIGURE 4.—Foreign-matter content of feeder samples for USDA stick-remover study 1969. (6-C, 6-cylinder cleaner; SR, USDA stick remover.)

lint-foreign-matter results essentially equal to the conventional seed-cotton-cleaning setup (No. 1) and better than the other three cleaning setups (fig. 5).

TABLE 6.—*Percentage of foreign matter in seed cotton for USDA stick-remover study, 1969*¹

Measurement component	Wagon sample	Feeder samples from gin-machinery arrangement No.—				
		1	2	3	4	5
Hulls	1.0	0.2	0.3	0.2	0.1	0.1
Sticks and stems .....	.4	.2	.2	.2	.2	.2
Large-leaf .....	.7	0.0	0.0	0.0	0.6	0.0
Small-leaf	1.6	.2	.3	.2	.2	.2
Total leaf	2.3	.2	.3	.2	.2	.2
Pin trash .....	.1	0.0	0.0	0.0	0.0	0.0
Motes .....	.6	.3	.4	.3	.3	.4
Total all foreign matter	4.4	.9	1.2	.9	.8	.9

¹ Wagon sample figures are averages of 270 samples, or 90 from each of 3 replications. Feeder sample figures are averages of 54 samples, or 18 from each of 3 replications.

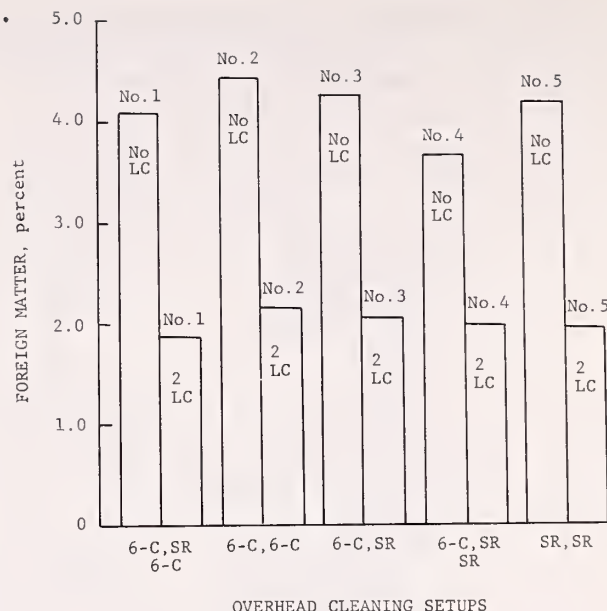


FIGURE 5.—Lint-foreign-matter content of seed cotton from five overhead cleaning setups followed by none and two lint cleaners, 1969. (6-C, 6-cylinder cleaner; SR, USDA stick remover.)

TABLE 7.—*Grade classification, moisture content, lint-foreign-matter content, and nep count of seed cotton for USDA stick-remover study, 1969*¹

Measurement	Lint cleaning ²	Seed-cotton samples from gin-machinery arrangement No.—				
		1	2	3	4	5
Grade characteristic: ³						
Grade, index	None	91.7	90.0	91.0	94.7	91.0
Do	2 LC	97.9	96.3	97.0	98.0	97.3
Staple length	32d inch	None	34.7	34.5	34.7	34.6
Do	32d inch	2 LC	34.7	34.7	34.7	34.7
Moisture content:						
Wagon	pct	None	8.4	8.6	9.2	9.4
Do	pct	2 LC	8.8	8.5	9.3	9.4
Feeder	pct	None	8.5	8.0	8.2	7.9
Do	pct	2 LC	7.7	8.1	7.8	7.9
Lint	pct	None	6.0	5.5	5.8	5.9
Do	pct	2 LC	6.0	5.6	5.6	5.9
Lint-foreign-matter content	pct	None	4.08	4.42	4.23	3.66
Do	pct	2 LC	1.89	2.15	2.05	1.97
Neps/100 in ² of web ⁴	None	14	11	15	17	14
Do	2 LC	22	20	20	25	22

¹ Grade and lint-foreign-matter data are averages of 27 samples, or 9 for each of 3 replications. Moisture and nep data are averages of 9 samples, or 3 from each of 3 replications. All setups included drying and feeder.

² LC, lint cleaner.

³ Grade index values—100 = Middling; 97 = Strict Low Middling plus; 94 = Strict Low Middling; and 90 = Low Middling plus.

⁴ Nep count values—Average = 11 to 20 and High = 21 to 30.

TABLE 8.—*Fiber and miniature spinning properties of seed cotton for USDA stick-remover study, 1969¹*

Measurement	Lint cleaning-	Seed-cotton samples from gin-machinery arrangement No.				
		1	2	3	4	5
Fiber property:						
50-pet span length inch	None	0.51	0.49	0.50	0.49	0.50
Do inch	2 LC	0.46	0.47	0.47	0.47	0.48
2.5-pet span length inch	None	1.15	1.14	1.14	1.14	1.15
Do inch	2 LC	1.10	1.12	1.12	1.12	1.12
Uniformity pct	None	41	43	44	43	43
Do pct	2 LC	42	41	42	42	42
Micronaire reading	None	4.2	4.2	4.2	4.2	4.2
Do	2 LC	4.2	4.2	4.3	4.2	4.3
Miniature spinning property:						
Yarn skein strength lb	None	108	109	108	109	109
Do lb	2 LC	104	105	104	103	106
Coefficient of variation pct	None	4.9	5.5	4.4	4.4	4.7
Do pct	2 LC	5.2	4.4	4.6	4.6	4.8

¹ Figures are averages of 9 samples, or 3 from each of 3 replications. All setups included drying and feeder.

² LC, line cleaner.

1970 STUDY

Equipment and Procedures

In 1970, the experiments were resumed to finalize evaluation of the USDA stick remover versus cylinder cleaners. Again, three series of experiments, using machine-picked seed cotton, were conducted.

The following five overhead-gin-machinery arrangements or setups were again used in addition to driers and feeder, with none and two lint cleaners:

1. 6-cylinder cleaner, stick remover, 6-cylinder cleaner.
2. 6-cylinder cleaner, 6-cylinder cleaner.
3. 6-cylinder cleaner, stick remover.
4. 6-cylinder cleaner, stick remover, stick remover.
5. Stick remover, stick remover.

Results

A summary of the seed-cotton-cleaning results for the experiments is given in table 9. The total foreign-matter content of the wagon samples

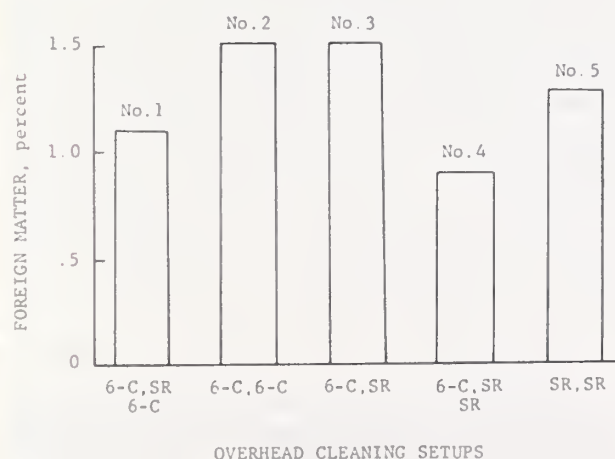


FIGURE 6.—Foreign-matter content of feeder samples for USDA stick-remover study, 1970. (6-C, 6-cylinder cleaner; SR, USDA stick remover.)

TABLE 9.—*Percentage of foreign matter in seed cotton for USDA stick-remover study, 1970¹*

Measurement component	Wagon sample	Feeder samples from gin-machinery arrangement No.—				
		1	2	3	4	5
Hulls	1.8	0.2	0.4	0.4	0.2	0.2
Sticks and stems . . . . .	.4	.2	.2	.2	.1	.2
Leaves	2.6	.5	.6	.6	.4	.6
Pin trash . . . . .	.2	.1	.1	.1	.1	.1
Motes . . . . .	.3	.1	.2	.2	.1	.2
Total all foreign matter	5.3	1.1	1.5	1.5	.9	1.3

¹ Wagon sample figures are averages of 90 samples, or 30 from each of 3 replications. Feeder sample figures are averages of 18 samples, or 6 from each of 3 replications.

TABLE 10.—*Grade classification, moisture content, and lint-foreign-matter content of seed cotton for USDA stick-remover study, 1970¹*

Measurement	Lint cleaning ²	Seed-cotton samples from gin-machinery arrangement No.—				
		1	2	3	4	5
Grade characteristic: ³						
Grade index	None	92.9	89.6	89.6	90.9	90.4
Do	2 LC	94.1	94.0	96.3	95.0	95.4
Staple length 32d inch	None	35.3	35.2	35.1	35.2	35.0
Do 32d inch	2 LC	35.2	34.9	34.7	34.8	34.8
Moisture content:						
Wagon	pct None	9.7	9.6	9.9	9.7	10.8
Do	pct 2 LC	9.7	9.7	8.9	10.4	10.6
Feeder	pct None	9.3	8.8	8.3	8.1	8.3
Do	pct 2 LC	9.3	8.4	8.1	8.2	8.2
Lint	pct None	6.8	6.4	6.1	5.9	6.1
Do	pct 2 LC	7.2	6.3	6.1	6.1	5.9
Lint-foreign-matter content	pct None	5.08	4.96	5.33	4.90	5.34
Do	pct 2 LC	2.81	3.09	3.28	2.88	2.90

¹ The data are averages of 9 samples, or 3 from each of 3 replications. All setups included drying and the feeder.

² LC, lint cleaner.

³ Grade index values—100 = Middling; 97 = Strict Low Middling plus; 94 = Strict Low Middling; and 90 = Low Middling plus.

was 5.3 percent, and this was reduced to a low of 0.9 percent at the feeder apron with the No. 4 setup, where single 6-cylinder and double-stick-

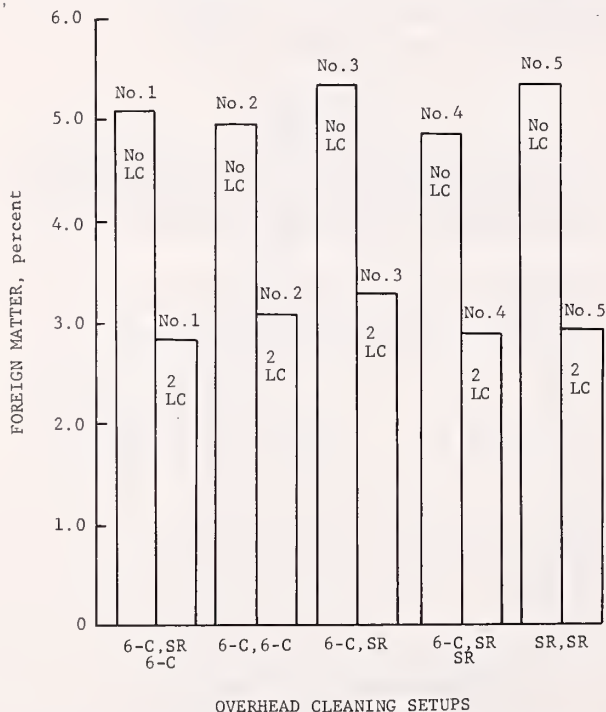


FIGURE 7.—Lint-foreign-matter content of seed cotton from five overhead cleaning setups followed by none and two lint cleaners, 1970. (6-C, 6-cylinder cleaner; SR, USDA stick remover.)

remover cleaning was used (figure 6).

Data on grade classification, moisture content, and lint-foreign-matter content are presented in table 10. The best all-round results, from a grade and cleaning standpoint, were obtained with the normal overhead setup (No. 1), consisting of 6-cylinder cleaner, stick remover, and 6-cylinder cleaner. The setup consisting of single 6-cylinder cleaning plus double-stick-remover cleaning (No. 4) was second in performance. In 1969 the No. 4 setup ranked first in performance.

As shown in table 10, in all cases about one-half of a grade or more was added by use of the two lint cleaners. Where double lint cleaning was used, Nos. 3, 4, and 5 setups ranked about the same in grade results. The double-stick-remover setup (No. 5) with lint cleaning (but without any cylinder cleaning) gave lint-foreign-matter results essentially equal to the conventional seed-cotton-cleaning setup (No. 1) and better than the Nos. 2 and 3 cleaning setups (fig. 7).

SUMMARY AND CONCLUSIONS

Data from the 1967 study showed that a commercial-type stick and green-leaf machine facilitates seed-cotton cleaning and contributes towards improved grades without having adverse effects on the fiber and spinning quality of cotton.

In the 3-year, USDA stick-remover investigation, five seed-cotton-cleaning combinations were tested with and without two stages of saw-cylinder lint cleaning. The results showed that there were no significant differences in any of the measured lint or yarn quality factors due to seed-cotton-cleaning machinery treatments. These data indicated that none of the seed-cotton-cleaning arrangements in combination with two stages of saw-cylinder lint cleaning was superior

to the conventional seed-cotton-processing arrangement of drier, cylinder cleaner, stick and leaf machine, drier, cylinder cleaner when used with two stages of lint cleaning.

Ginners and gin manufacturers may be interested in considering the results of these studies in their new installations and in making any future changes in their seed-cotton-cleaning machinery arrangements.

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